Storage Dynamics of Miners Creek: a Conversation on Watersheds and BDAs

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SCOTT RIVER
WATERSHED COUNCIL

HUMBOLDT STATE UNIVERSITY
H
FOUNDED 1913

Outline

- Introduction to Miners Creek
- Methodology
- Results
- Discussion/Questions

Introduction - Miners Creek

Klamath Watershed ~31,080 Km^2

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Scott River Watershed ~2106 Km^2

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French Creek Watershed ~85 Km^2

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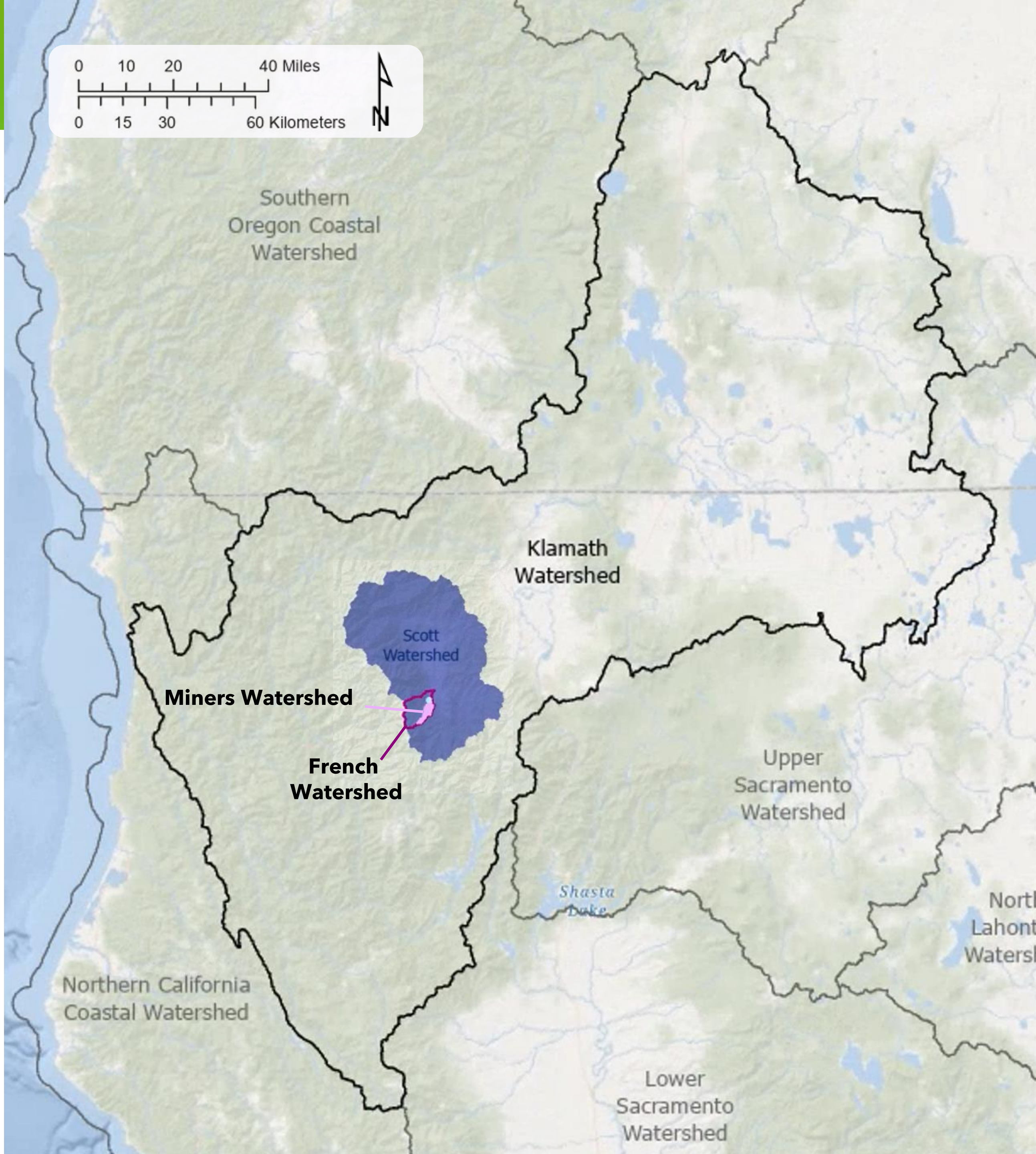
Miners Creek Watershed ~20 Km^2



Introduction - Miners Creek

Miners Creek Watershed ~20 Km^2

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896-2145m

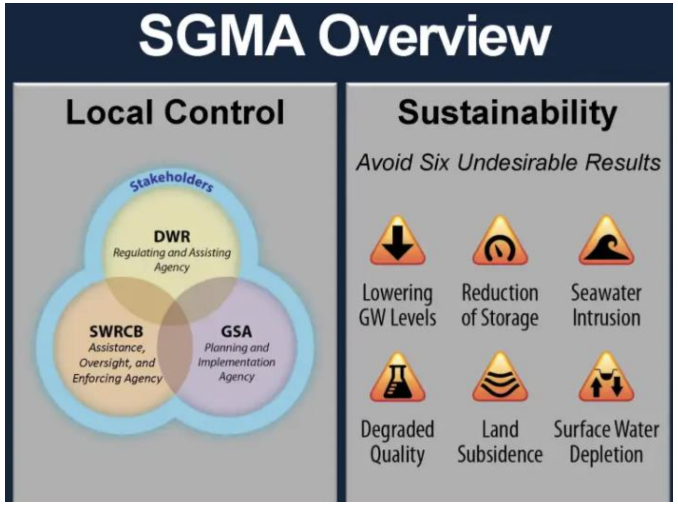
0% lakes or ponds

650 mm average precipitation

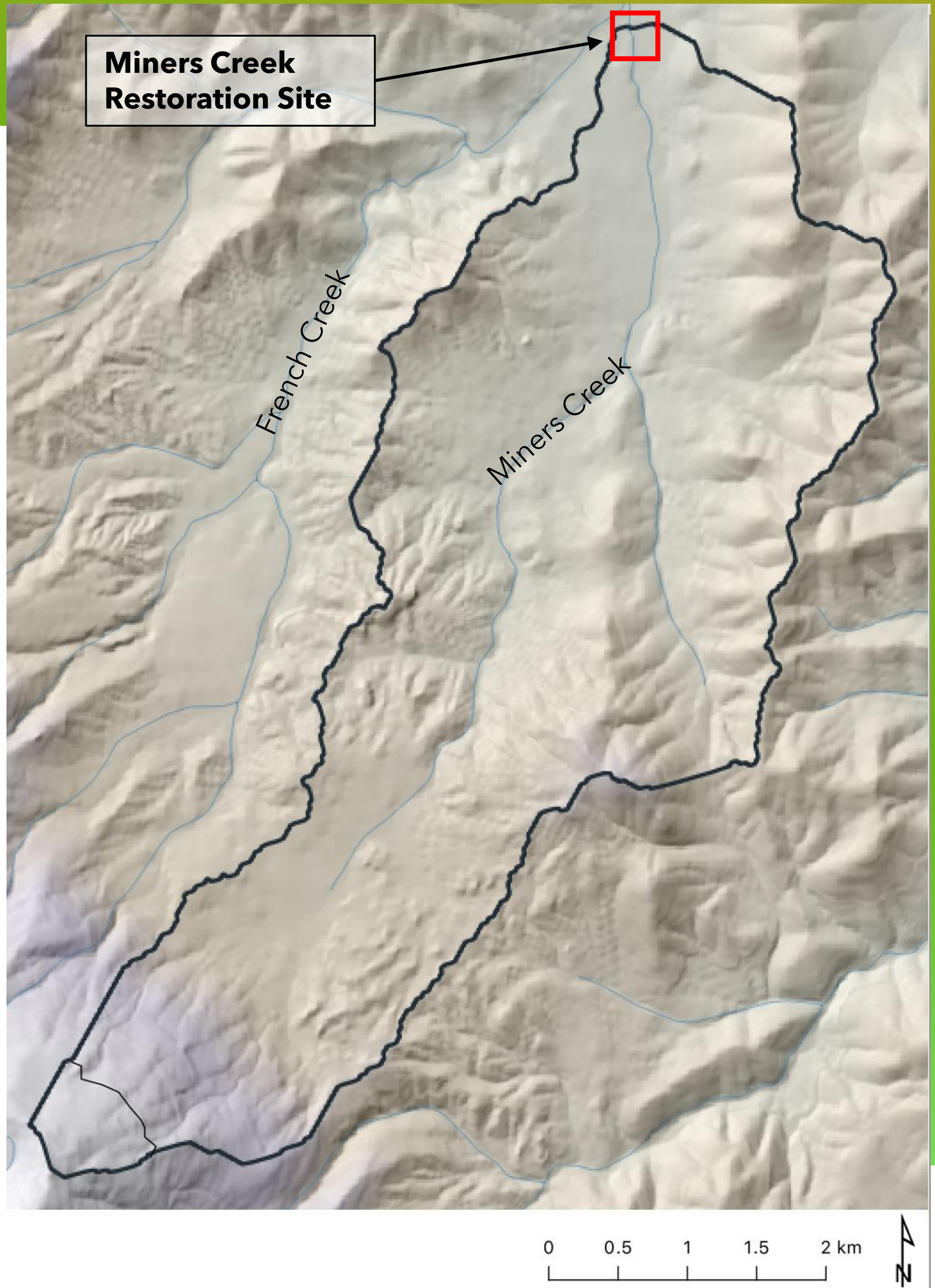
2.27% above 1828 m

Coho Habitat

https://www.fisheries.noaa.gov/species/coho-salmon



https://mavensnotebook.com/2020/06/10/state-water-board-update-on-sgma-implementation-2/



Introduction - Miners Creek

Miners Creek Restoration Site

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~462 m of stream

~175 m upstream of French Creek

~1.1% channel gradient

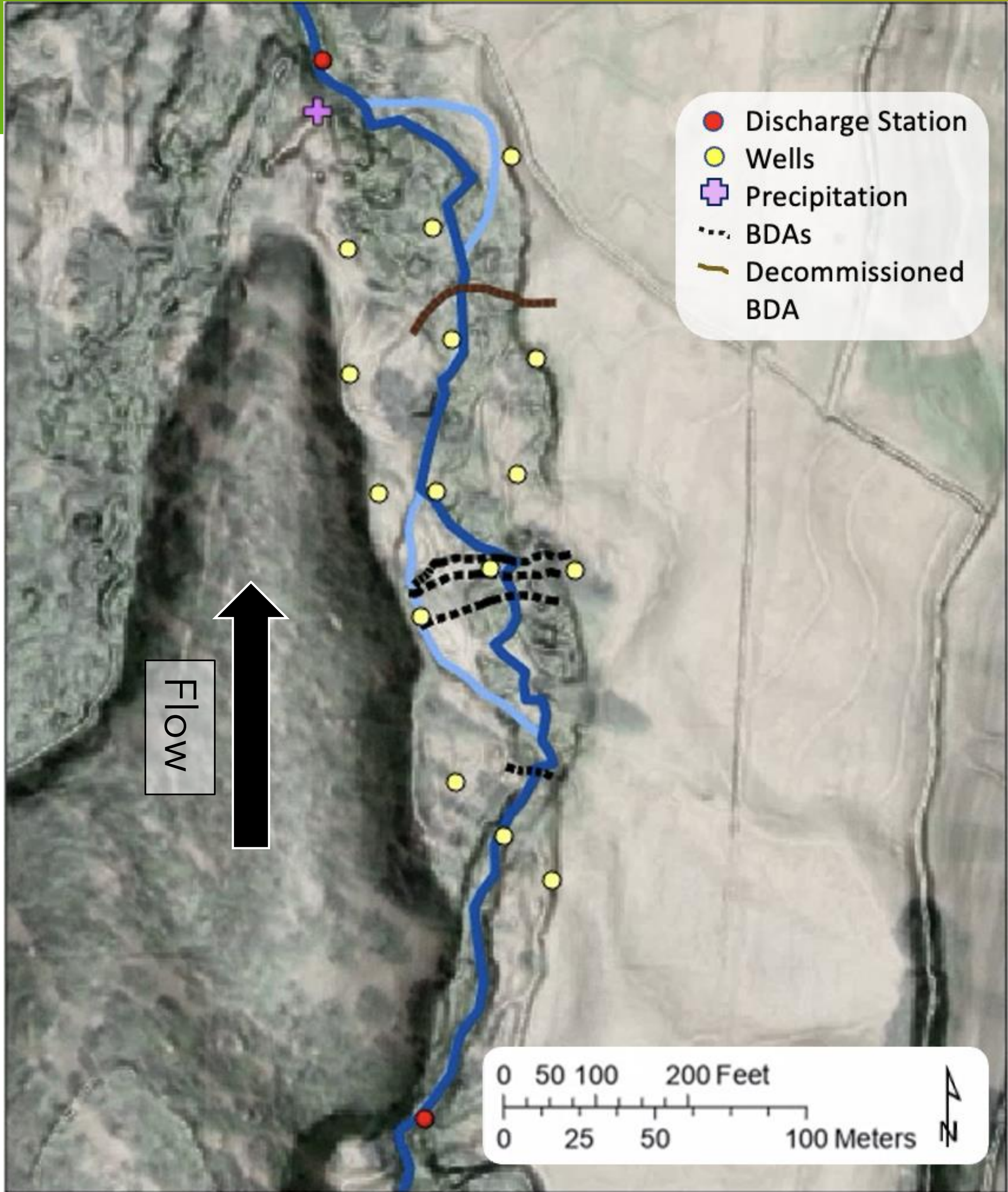
Largely Decomposed Granite (DG)

15 Shallow Groundwater (GW) wells (WY21)

2 Discharge Stations (WY 21)

1 Precipitation Station (WY 21)

4 Beaver Dam Analogues (BDAs)



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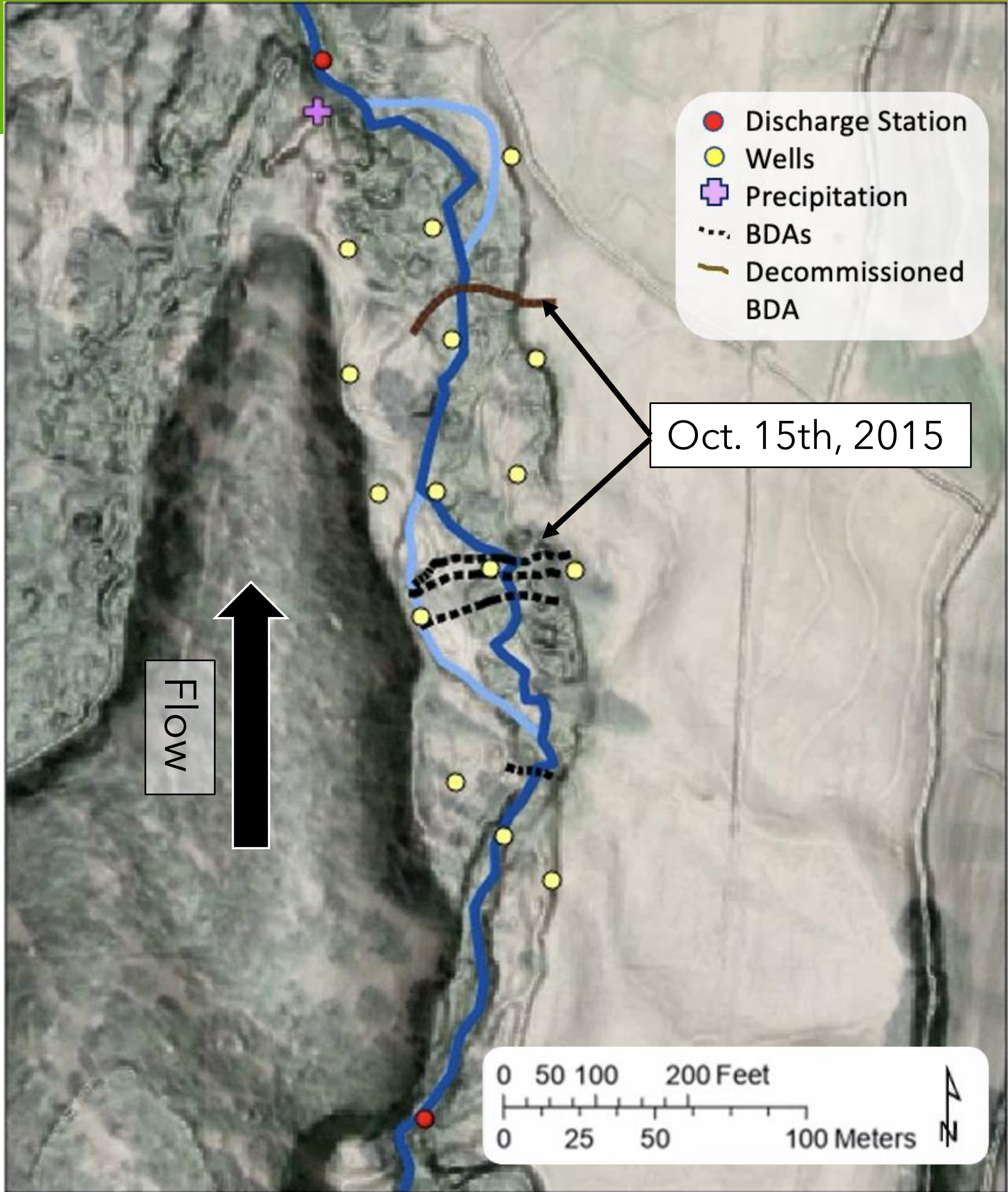

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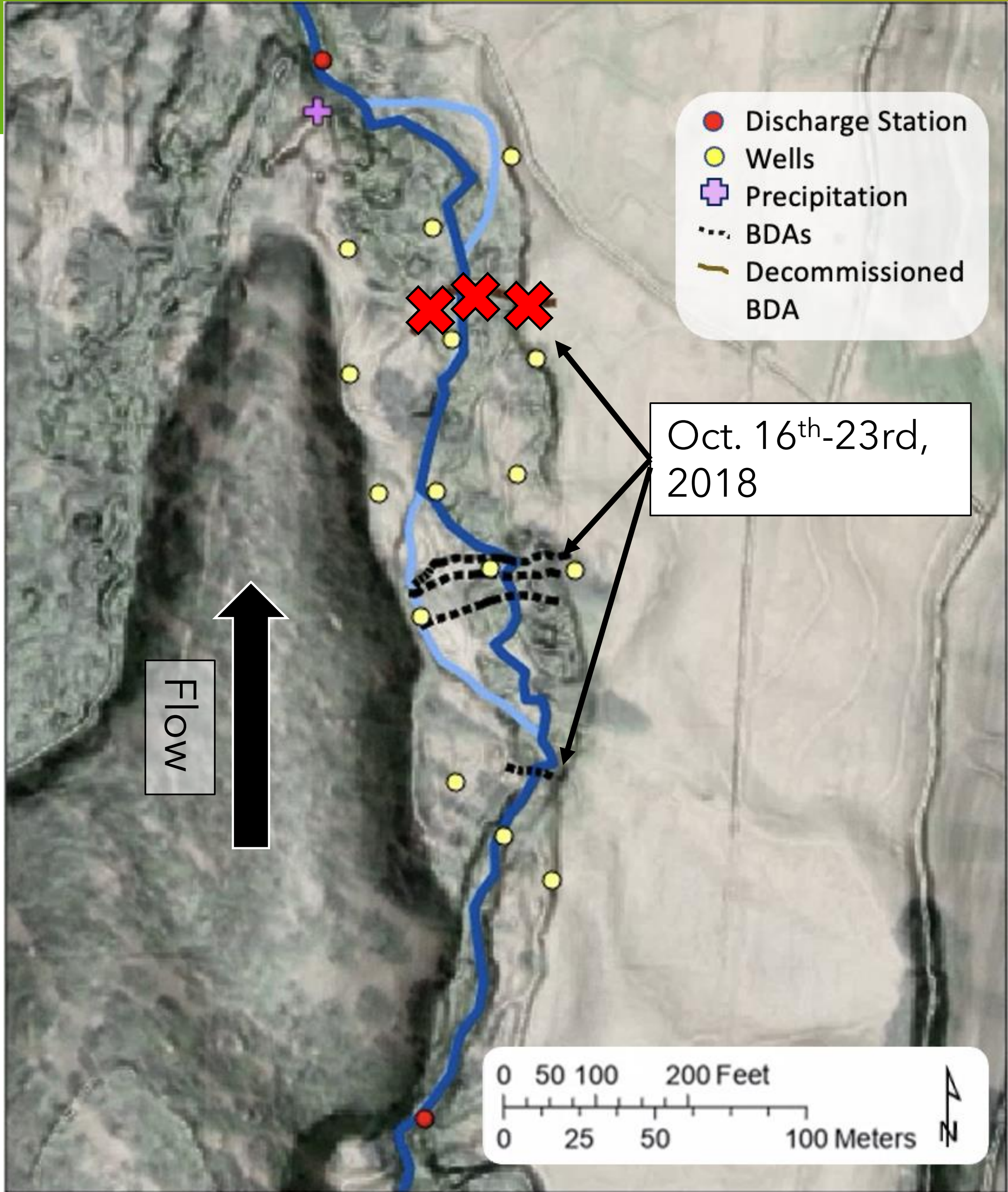
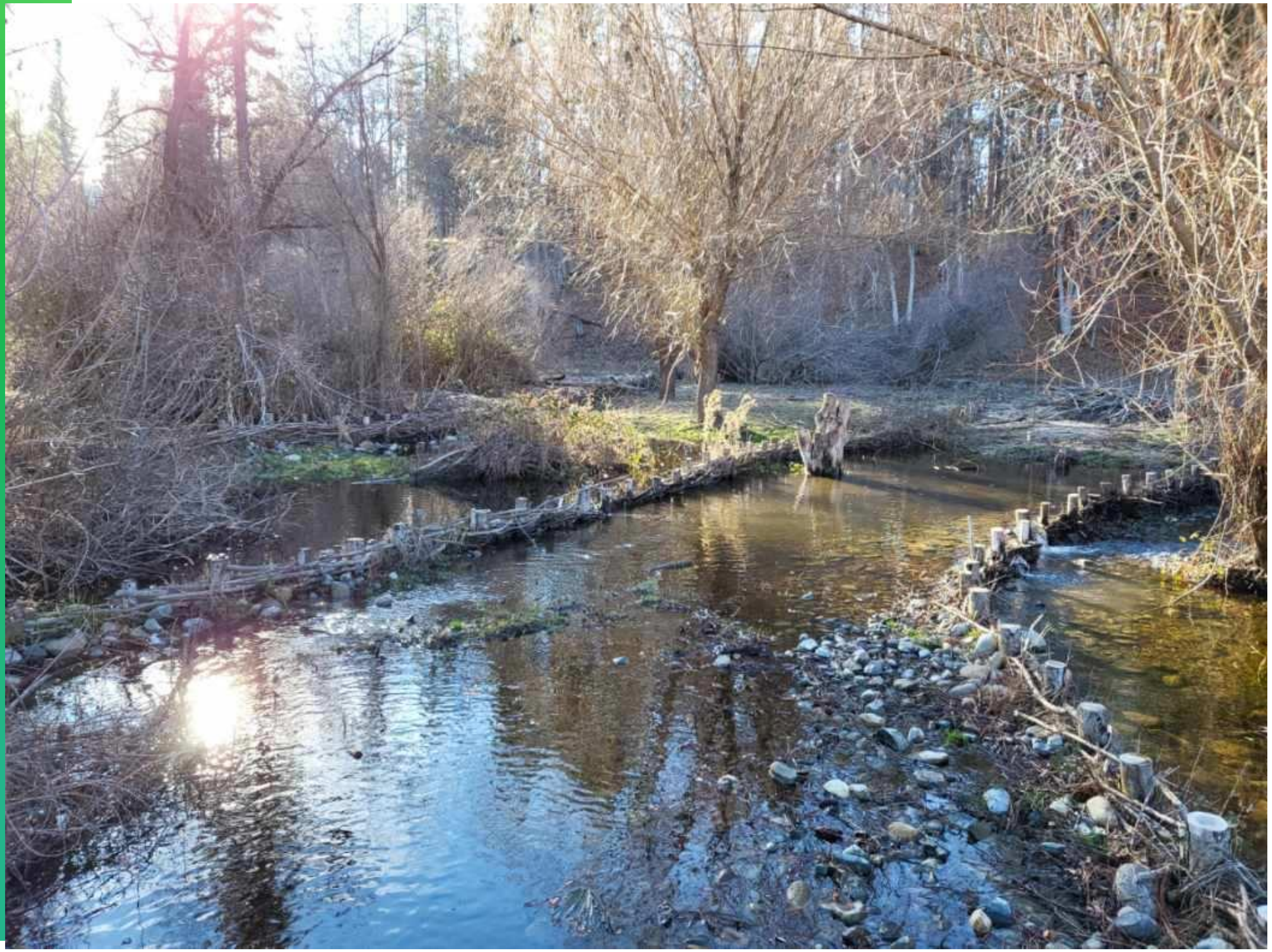


Introduction - Miners Creek – Downstream BDAs



Goals

1. To explore the contributions BDA's have in storing water relative to reach scale storage dynamics

2. To discuss the factors that impede surface volume storage

3. Highlight the roles a watershed has in supporting BDA ponding.

Methodology - Discharge

Water year 2021 Discharge

-installation of upstream (US) and downstream (DS) stations
-12 measurements at each station (4-180 L/s)
-Least Squares Regression Model used to establish stage discharge relationship
-Values converted into daily values (RStudio)

Downstream Station

Upstream Station

Methodology - Water Surface Elevation

Processing 6 years of well data

- Hobo Onset Temperature and Pressure loggers (15 min data)
- Compensated via Hoboware
- Converted into daily WSE

Precipitation data

-California Data Exchange Center (CDEC) (Water year 2016-2020)

- Hobo Onset tipping bucket (Water year 2021)

Methodology – Storage Dynamics - Groundwater Storage

$h * A * Sy$

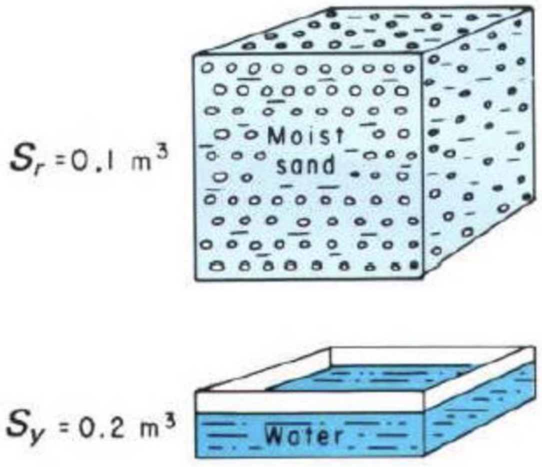
Karren et al. 2018

Where,

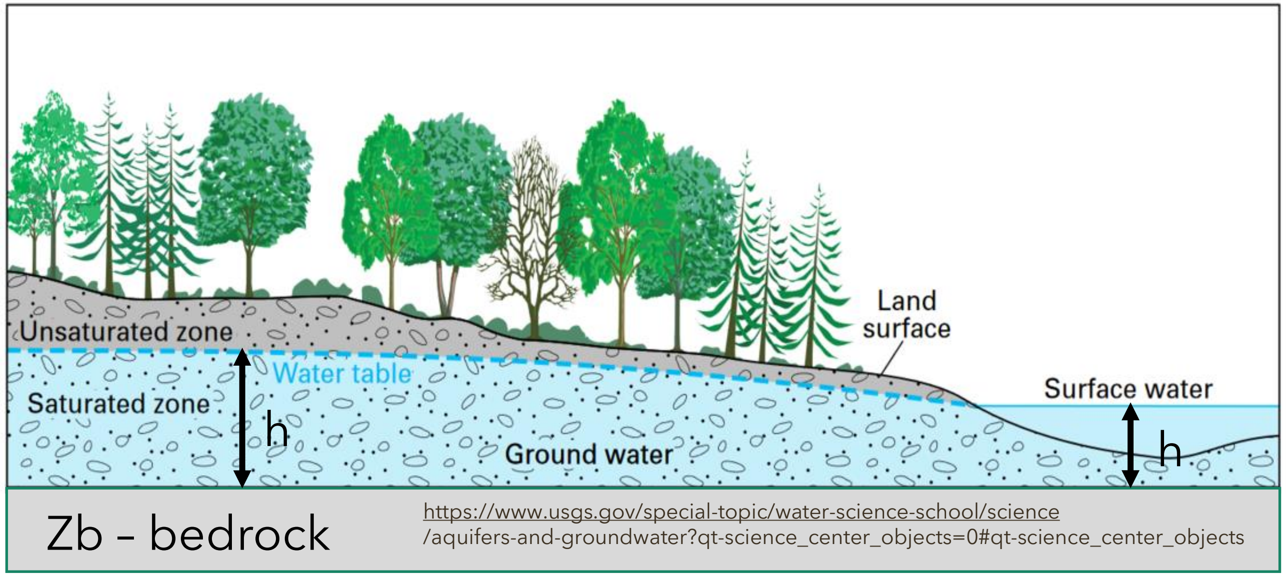
h = daily average head relative to Zb (boundary layer)

A = area of aquifer derived by well network and LiDAR Imagery

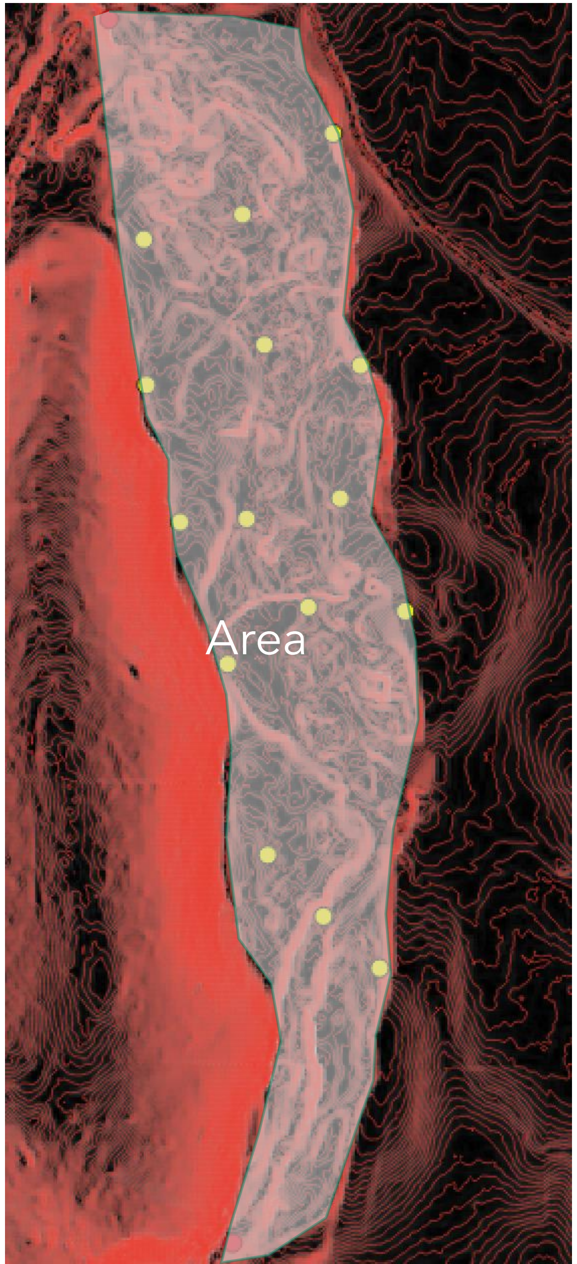
Sy = Specific Yield



http://www.aqtesolv.com/aquifer-tests/aquifer_properties.htm



https://www.usgs.gov/special-topic/water-science-school/science/aquifers-and-groundwater?qt-science_center_objects=0#qt-science_center_objects



Methodology – Storage Dynamics – Reach Scale

$$Q_{down} - Q_{up} = Q_{reach}$$

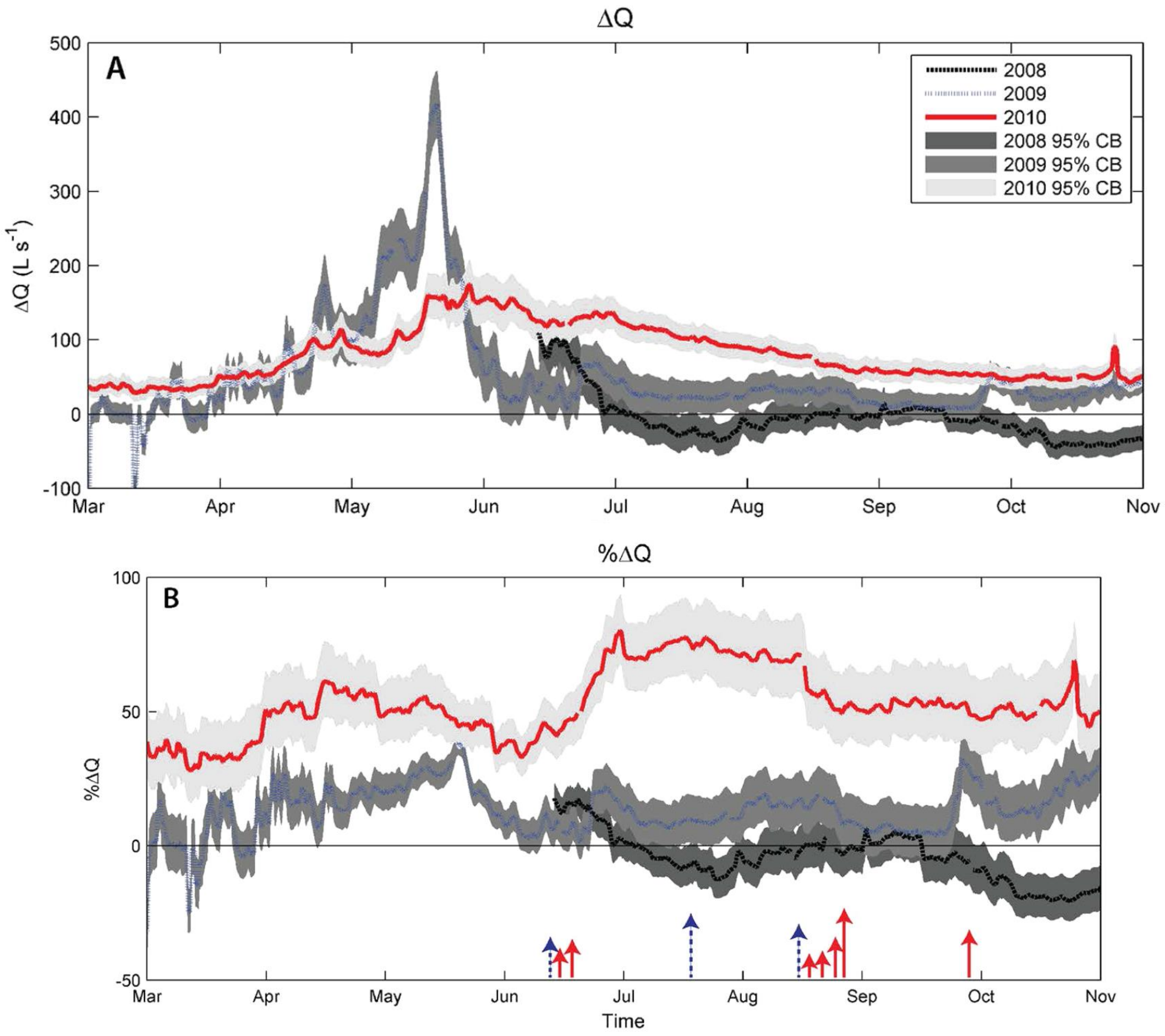
Where,

Qdown = downstream discharge

Qup = Upstream discharge

Qreach = Reach scale discharge

Units for all variables = (m^3/day)



Majerova et al. 2015

Methodology - BDA Surface Volume Estimates

Karren et. al 2016

$$V(h) = \int_0^h s\left(\frac{h^*}{h_0}\right)^{2/p} dh^* = \left(\frac{s}{1+2/p}\right)\left(\frac{h^{1+2/p}}{h_0^{2/p}}\right).$$

Where,

V(h) = surface volume

s = scaling coefficient

p = pond morphometry coefficient

h = height above pond bottom

h_0 = unit height of water surface (1m for SI)

$$s = A_1\left(\frac{h_1}{h_2}\right)^{-2/p}, \qquad p = 2\left(\frac{Log\left(h_1/h_2\right)}{Log\left(A_1/A_2\right)}\right),$$

A_1, A_2 = pond surface areas

$h_1 < h_2$

Max Surface Volume Estimate

$$V_{\max} = \frac{A_{\max} \times h_{\max}}{1 + 2/p}.$$

Methodology - Water Balance and Discharge Thresholds

Sayama et al. Method (2011)

$$dV(t) = \sum_{t=1}^{T} (R(t) - Q(t) - E(t))$$

Threshold relationships established by plotting discharge/dV

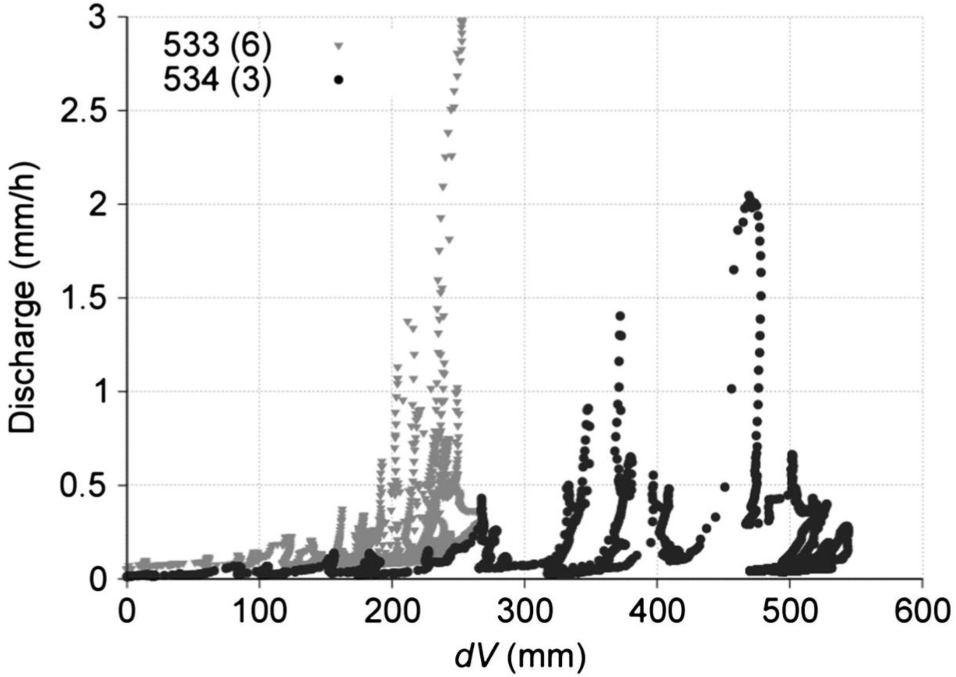
dV(t) = total storage change from t=0 to t

R(t) = average rainfall (mm/day)

Q(t) = discharge (Runoff mm/day)

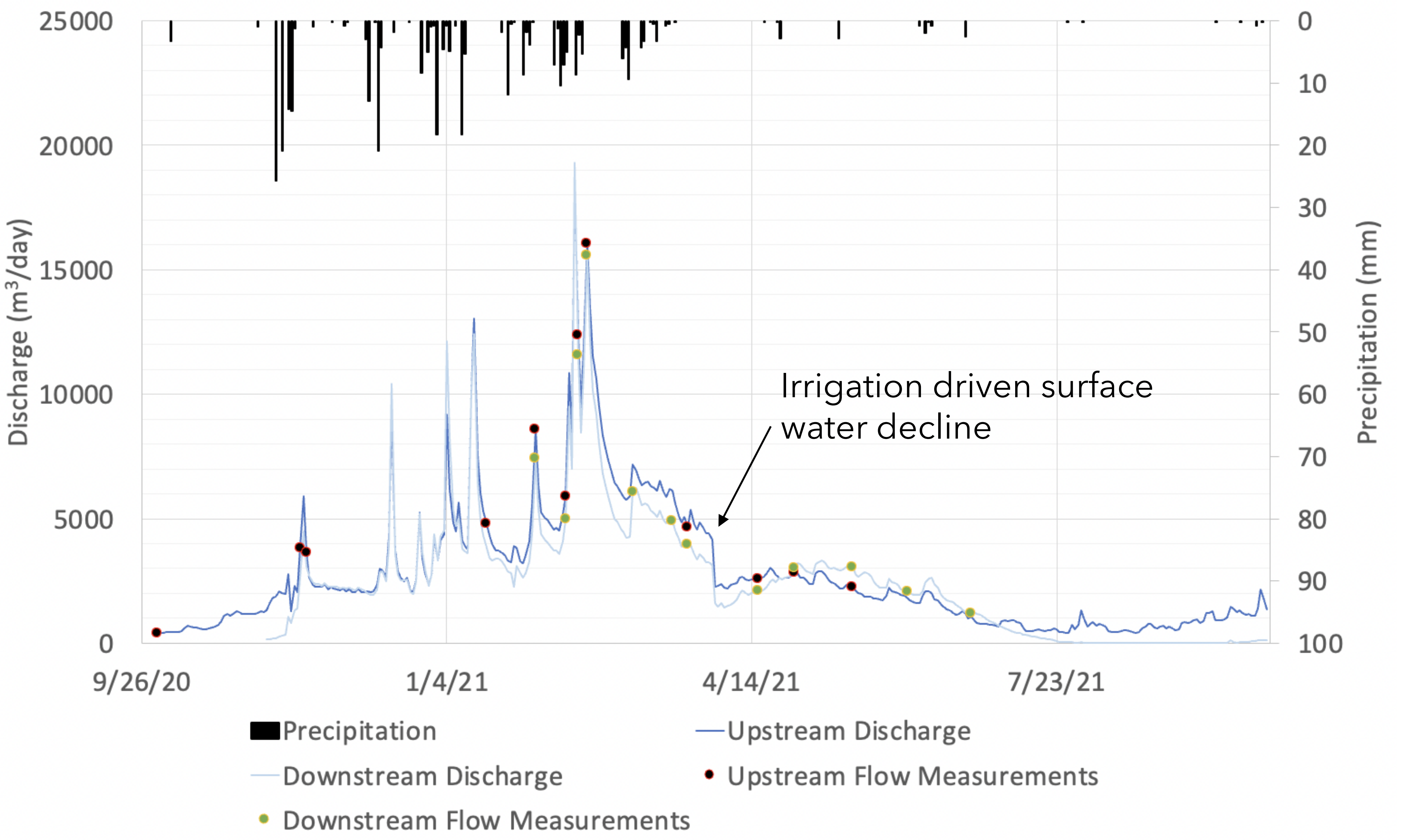
E(t) = evapotranspiration (mm/day)*

*E(t) measured by a California Irrigation Management Information System (CIMIS) ~21km off site **

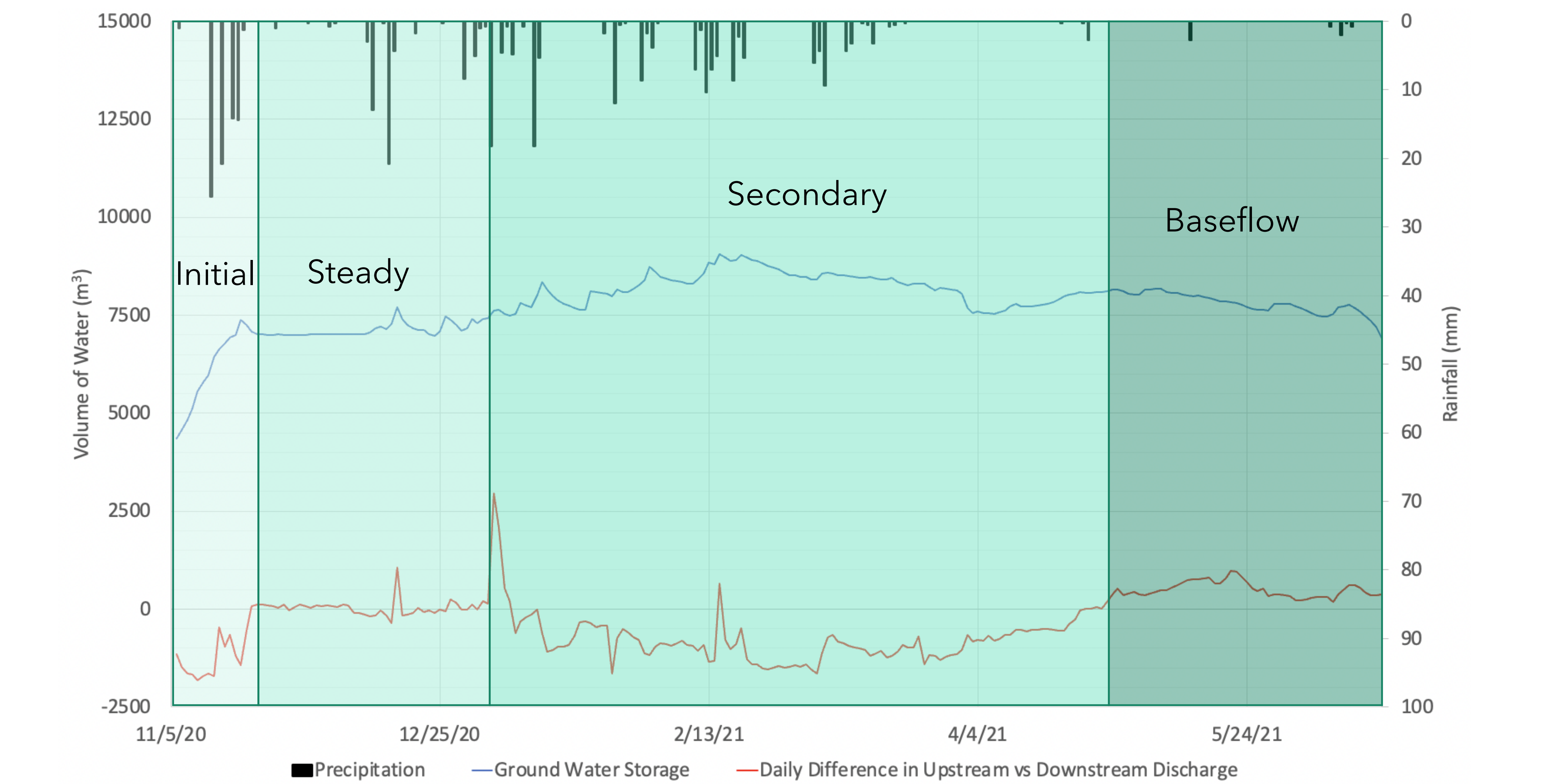


Sayama et al. 2011

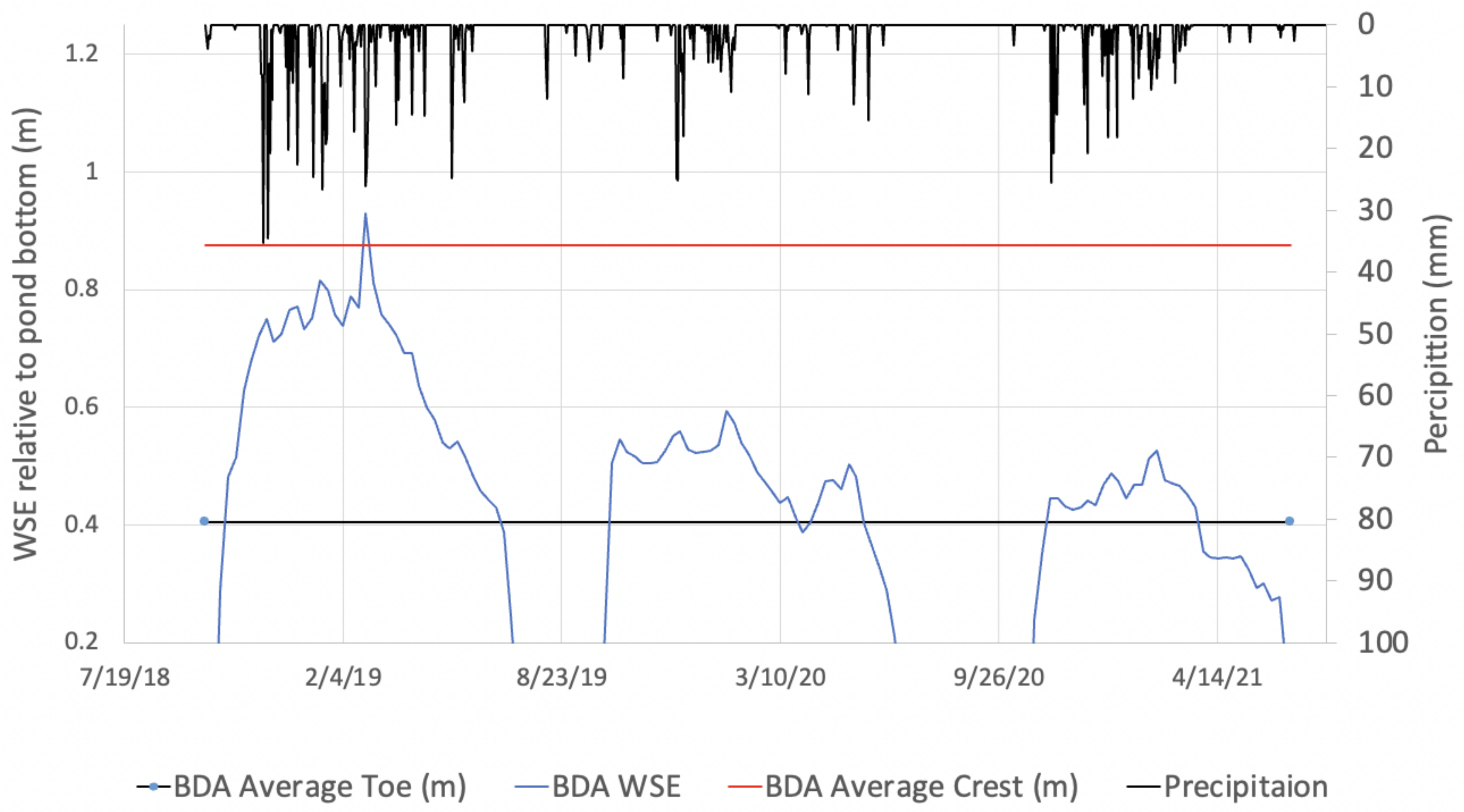
Results – Discharge



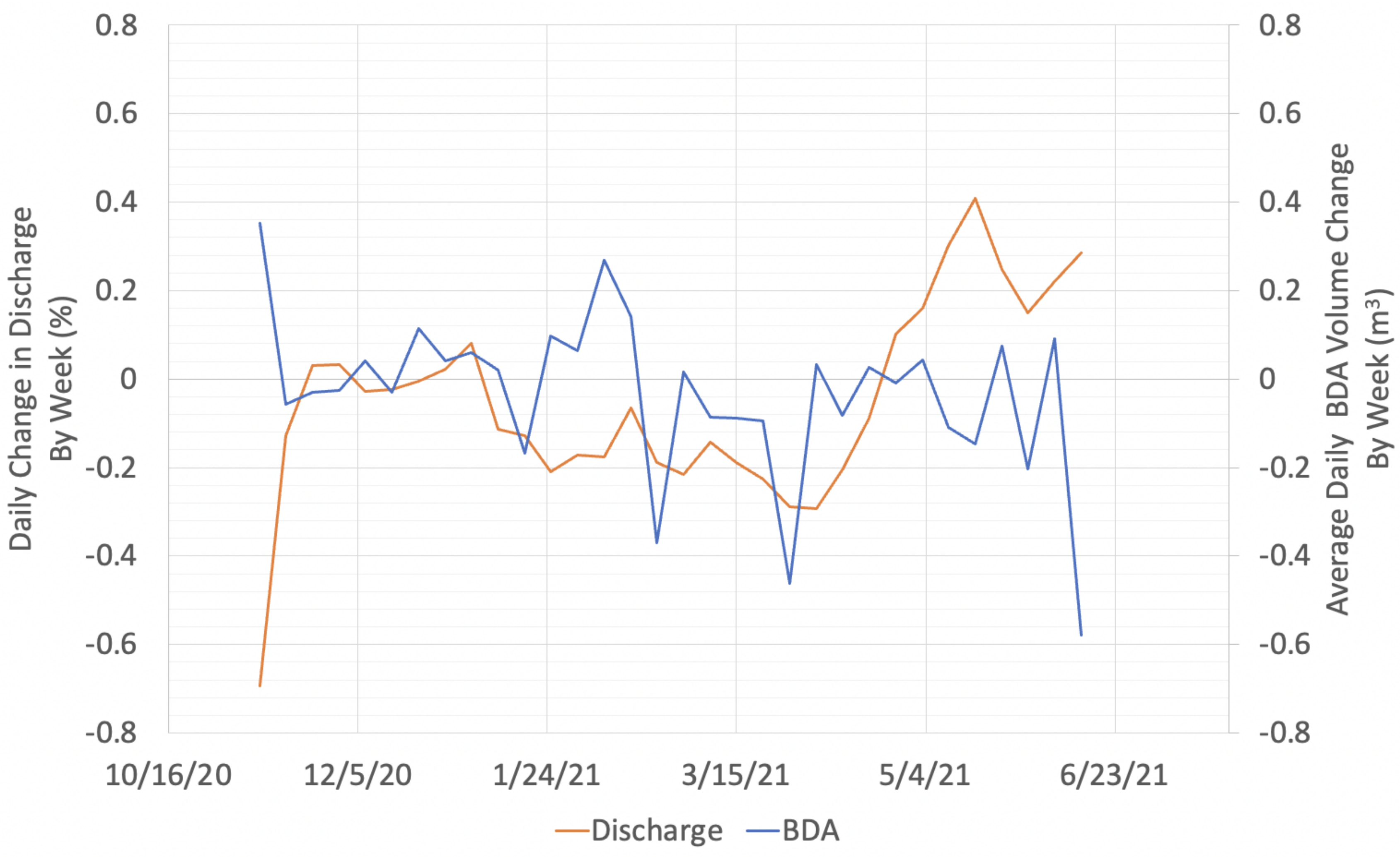
Results - Groundwater Storage



Results - Water Surface Elevation – BDA Fill



Results - Reach Scale Storage Dynamics



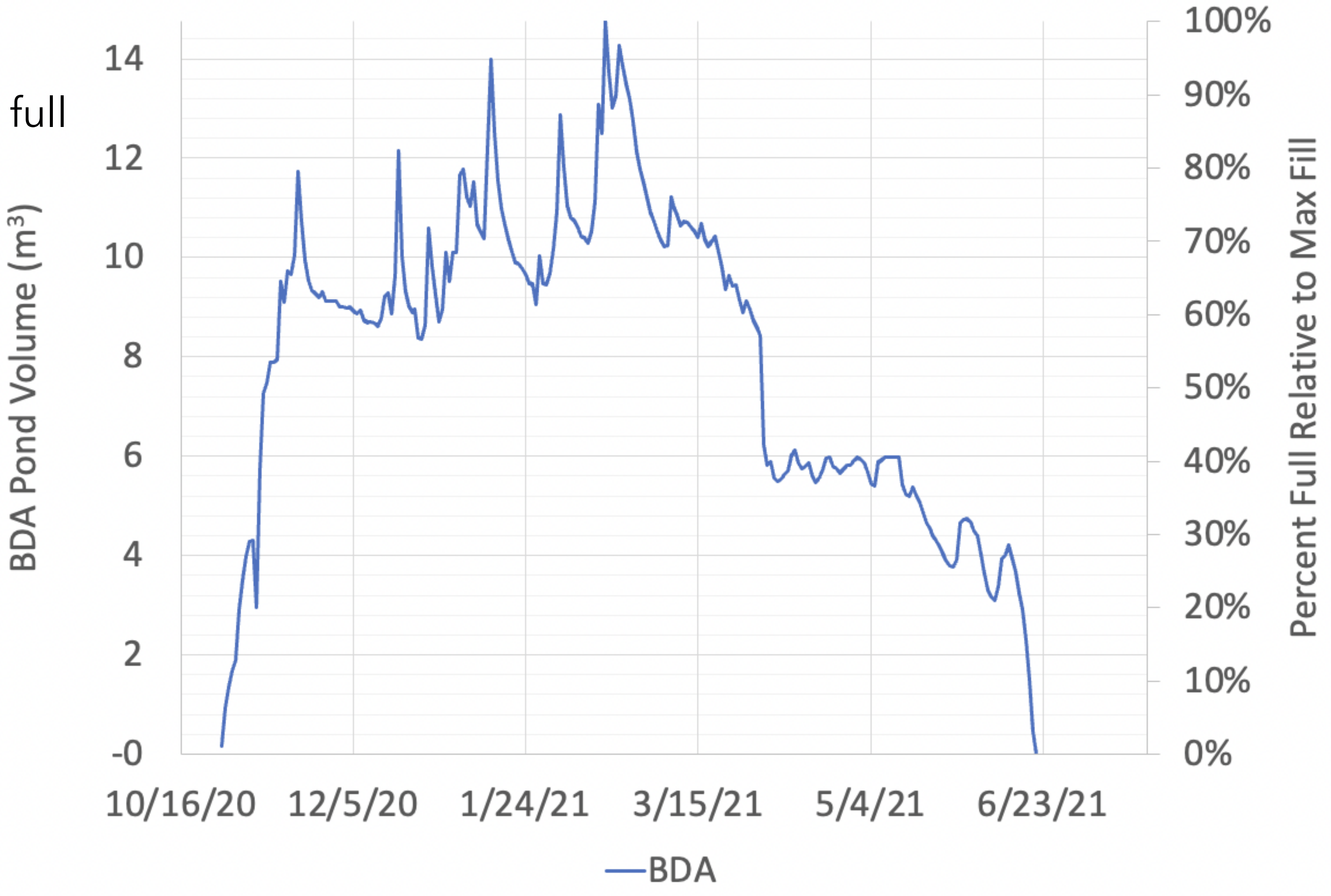
*Change in discharge = (Qdown-Qup)/Qup

Results - BDA Surface Volume Estimates

Max potential ~ 57.26 m^3

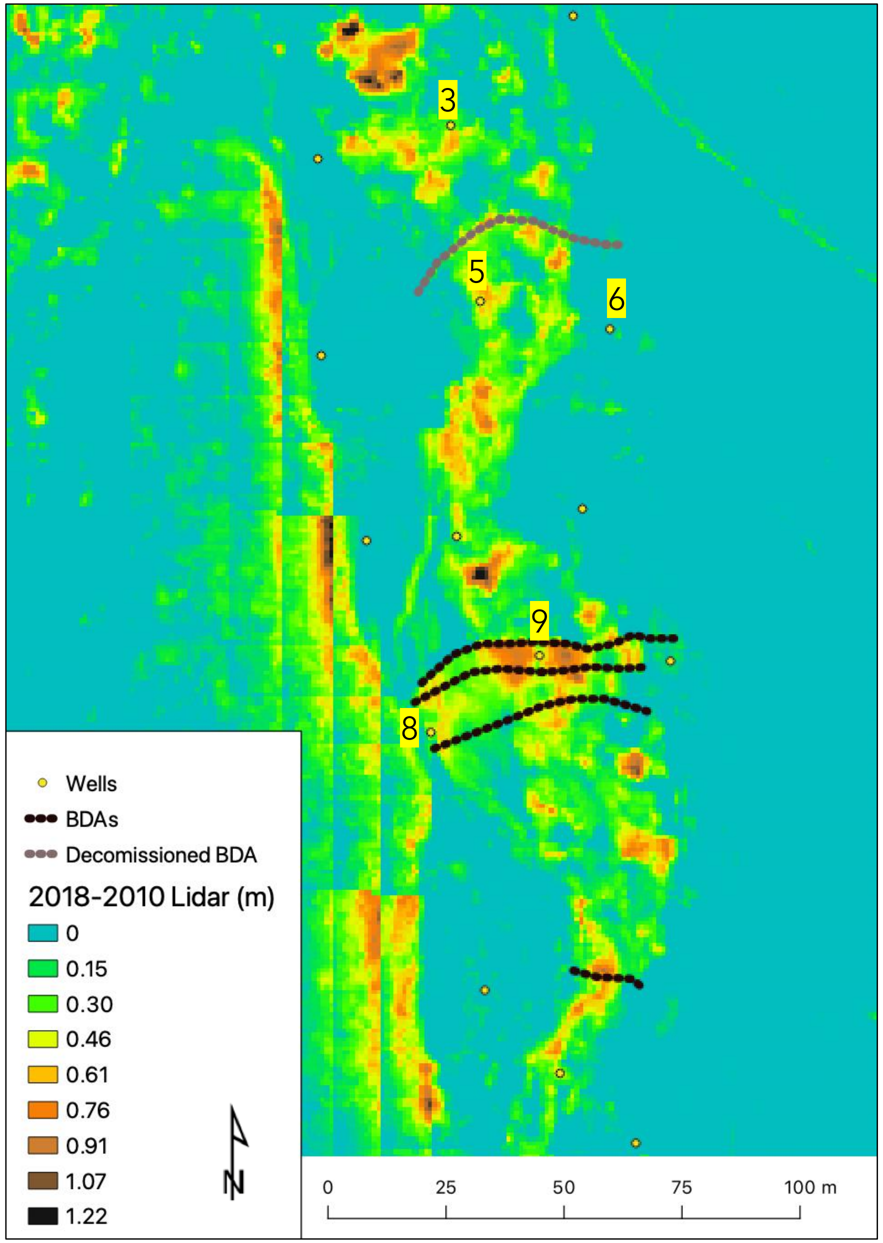
During WY 21max BDA ~25% full

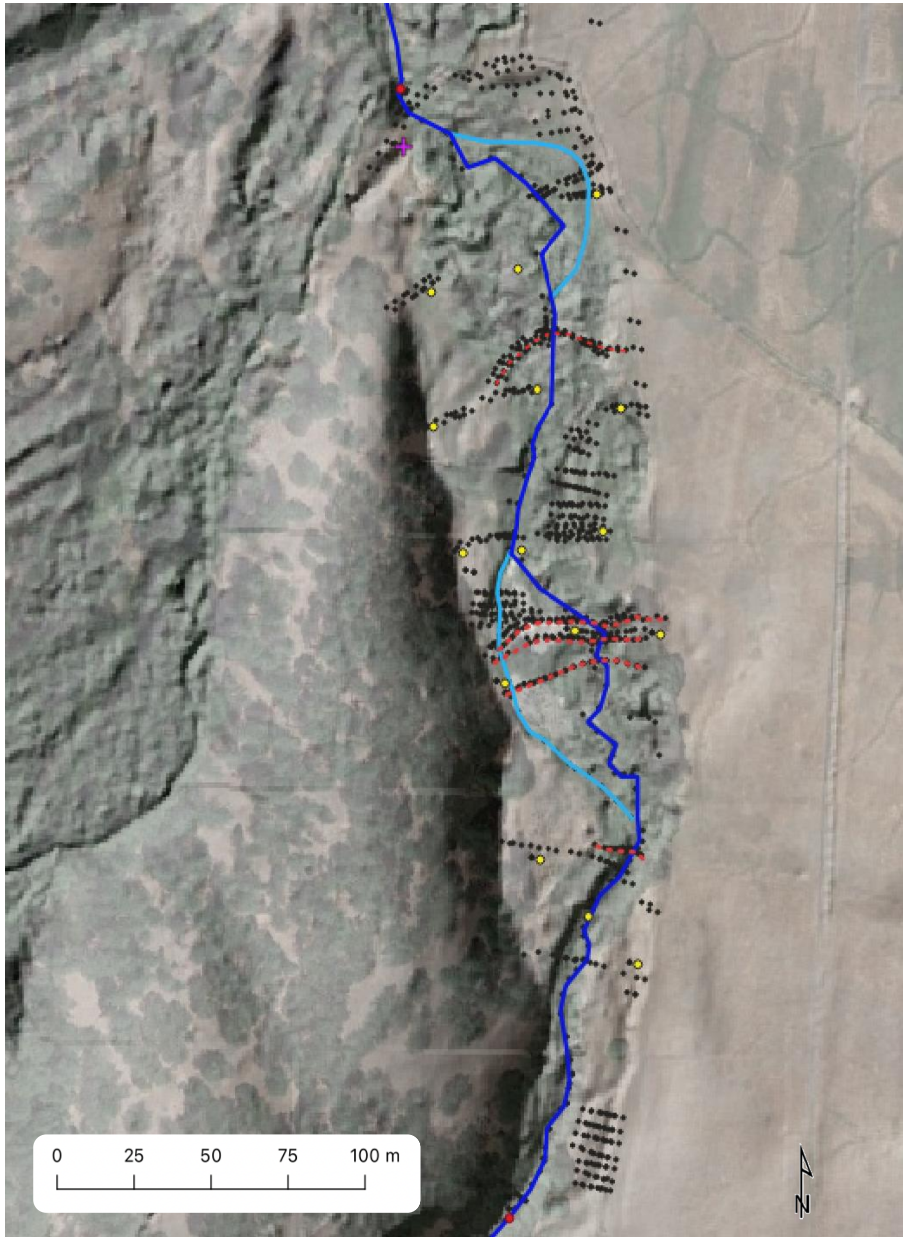
Ave WY 21 = 55%



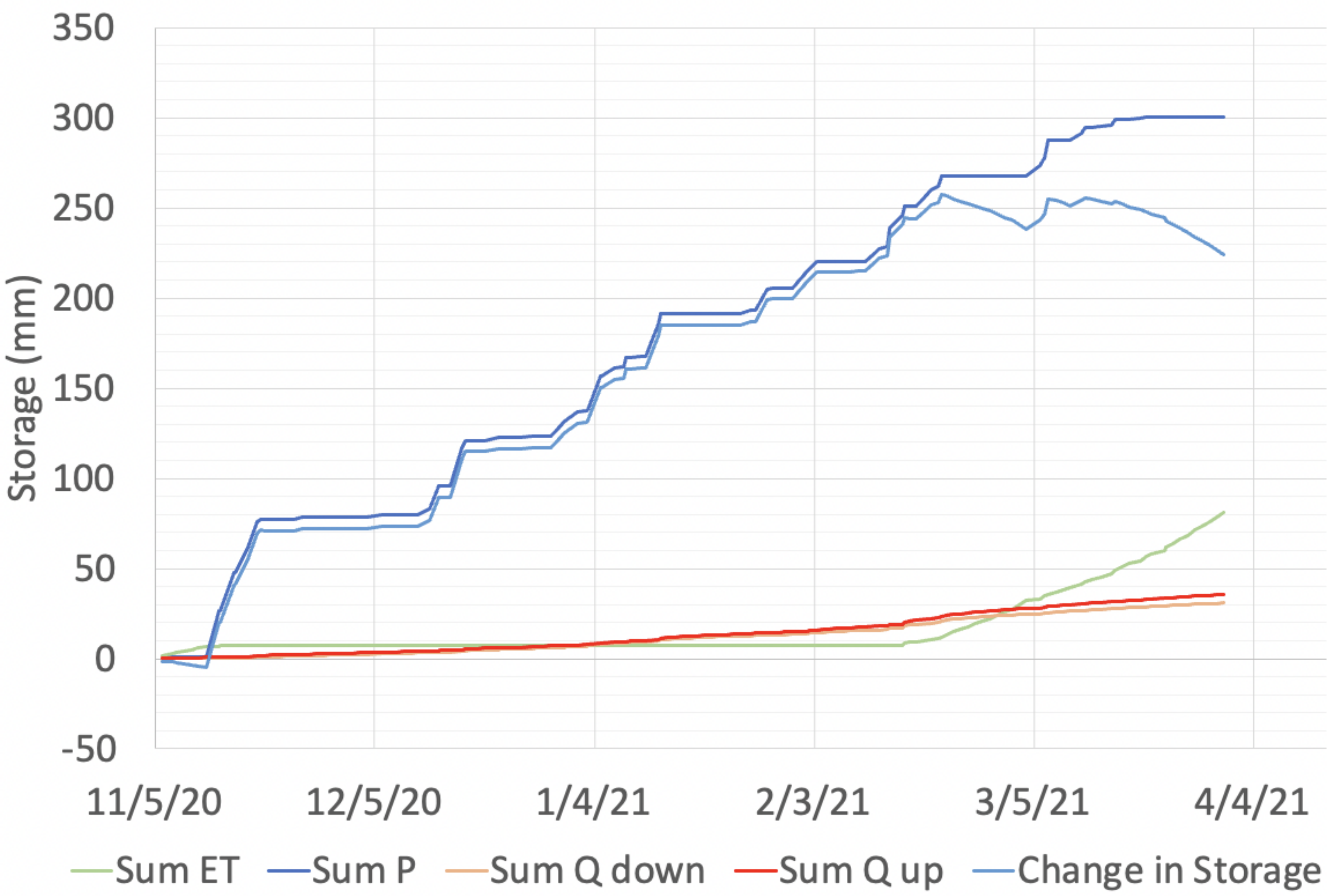
Discussion - Miners Creek - BDAs

Discussion - Stream Channel and Well Network Survey





Discussion - Water Balance and Discharge Threshold



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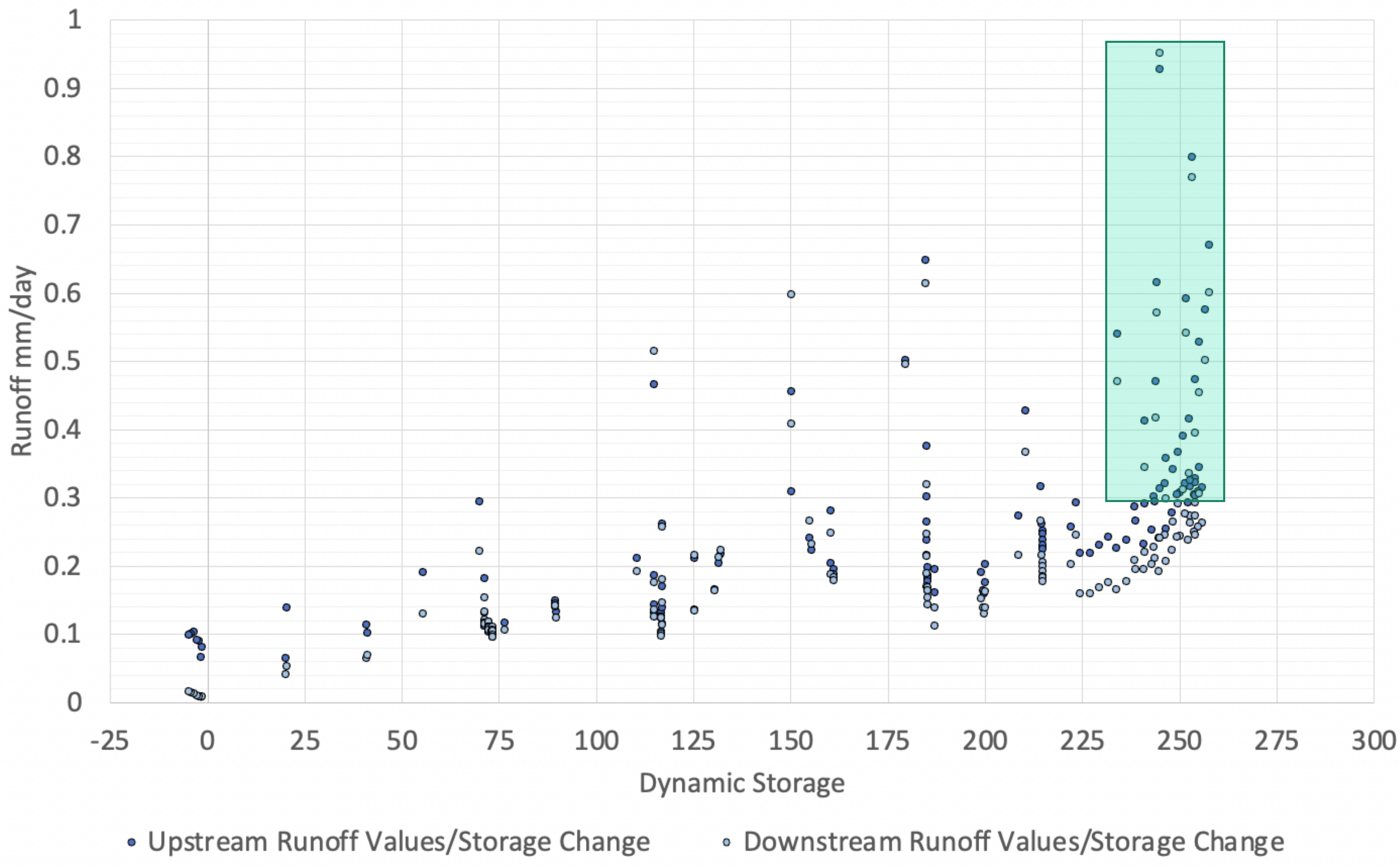

Discussion/Questions

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